A Printed Circuitboard Analyzer for Characterizing the Charge and Mass of Martian Dust

Completed Technology Project (2017 - 2020)

Project Introduction

We propose development of a device that will directly measure both the electrical charge and the mass of atmospheric dust particles on Mars. Such measurements have never before been made on Mars, but are critical to understanding the possible effects of dust on human Mars activities and in situ resource utilization. These measurements will also inform models of weathering and atmospheric effects on Mars. The device consists of an array of image charge detectors made using printed circuit boards. Particle charge is measured directly for each grain that enters the instrument. Mass is determined by electrostatically slowing the particle in a region between two detection arrays. The proposed effort seeks to develop this device from TRL 2 to TRL 3, including testing with charged Mars dust simulant. The proposal includes development of a low-noise amplifier that greatly exceeds the performance of the heritage Amptek amplifier. Science goals of the proposed device include measurement of the electrical charge and mass of a large number of individual dust grains that are blown through the instrument. It will also be possible to include a pump or blower and force particle-laden air through the instrument. The proposed research is directly relevant to Mars exploration and science. Electrostatic adhesion of dust is expected to be an issue in human exploration of Mars (sticking to astronaut suits as occurred during lunar surface missions, possible respiratory effects, etc.) and also to mechanical operations such as ISRU processing of the Martian atmosphere to produce oxygen. Prior measurements constrained general size distributions via optical scattering, but neither charge nor mass has been directly measured. Further, no instruments have been selected on any upcoming Mars missions (ExoMars, Mars2020, InSight) that are able to make these measurements. Thus the proposed work directly advances our understanding of the dust properties and processes on Mars. Further, the proposed effort falls best into the PICASSO program because if the TRL level development, the fact that this is instrument development, and the planetary-specific targets for the instrument type.

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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Planetary Instrument Concepts for the Advancement of Solar System Observations

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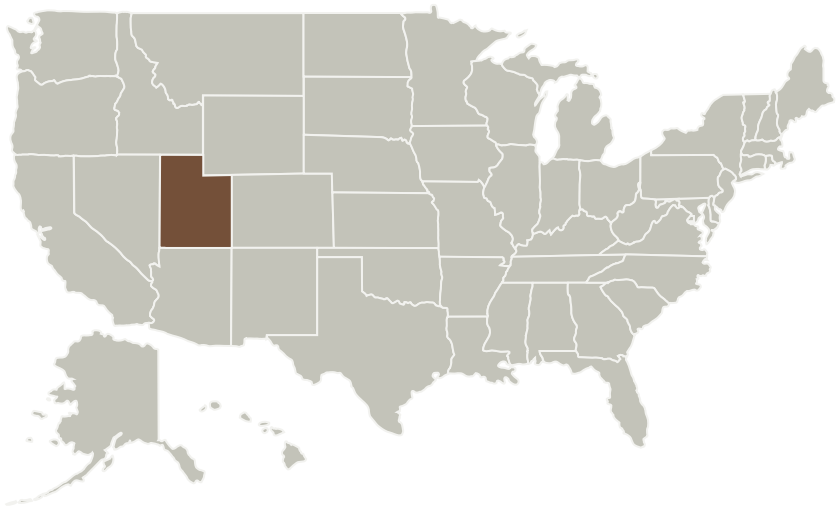
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Brigham Young University-Provo	Supporting Organization	Academia	Provo, Utah

Primary U.S. Work Locations
Utah

Project Management

Program Director:

Carolyn R Mercer

Program Manager:

Haris Riris

Principal Investigator:

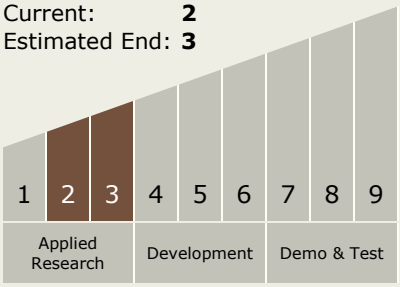
Daniel E Austin

Co-Investigators:

Gary R Reynolds
Aaron R Hawkins
Shiuh-hua Wood Chiang

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.3 In-Situ Instruments and Sensors
    - TX08.3.1 Field and Particle Detectors

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Target Destination

Others Inside the Solar System